

SIRE BREEDING VALUES FOR DAUGHTERS' FERTILITY IN THE NETHERLANDS

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1. Introduction

Fertility is a trait which can be measured in many different ways. A number of definitions found in the literature are: NR56 (non-return percentage after 56 days), NR28, percentage calvings after the first insemination, number of days open, calving interval(CI), interval calving-1st insemination, number of inseminations per pregnancy, and many more.

Furthermore, fertility traits can be measured on yearlings, heifers and older cows. These three physiologically different groups of animals give information on the fertility of an animal in the rearing period, an animal during lactation which still grows, and an animal during lactation. Fertility measured on yearlings is not a good predictor for the fertility of heifers.

When selecting animals for breeding and taking fertility into account, the first question raised is which fertility traits one should select and which traits should be considered as part of the breeding goal.

2. Choice of trait in breeding goal

Fertility traits can be divided into two kinds: interval traits and fertility scores. With interval traits the number of days of a certain fertility status is measured. For example: the number of days are between calving and first heat detection, or the number of days between two calvings. With fertility score the percentage of animals in a certain fertility status is measured. Examples are: NR28, NR56.

A good cow fertility could be defined as an animal in lactation, which shows her heat in time and gets pregnant after the first insemination. When an animal meets these requirements, she will automatically have the desired calving interval. Furthermore no waste of labour and semen occurred.

Showing in heat in time can be deduced from heat detections by the farmer. However, these data are not available. The next best information source is the insemination data, from which the interval between calving and first insemination (ICI) for heifers can be derived. This trait is highly correlated with start of the heat (>.90) and has a reasonable genetic correlation with calving interval (.78). Besides that, ICI is scored on more cows than CI; of 2/3 of the cows with ICI data, CI is also known. ICI has a higher heritability (.06) than CI(.04), a breeding value for ICI can be estimated with higher reliability than a breeding value for CI. By shortening ICI via selection, CI also will be reduced.

Determining an animal is pregnant after the first insemination can be done by computing the percentage calvings (%CALF) after first insemination. The disadvantage of this trait compared to NR56 is the late availability of the trait and are available to be scored on less animals (2/3 of the animals used to calculate NR56 can be used for determining the percentage calvings). Furthermore there is a strong genetic correlation (.93) between NR56 and %CALF. NR56 is the best figure to determine the pregnancy rate after the first insemination for a group of daughters of a bull. Usage of NR56 results in a breeding value with a higher reliability than %CALF, while selecting on NR56 gives at least the same response for %CALF than direct selection on %CALF.

A further consideration is the data to be used for the calculation of breeding values. Research of Ouweltjes (1992) and De Jong (1993) shows a positive, but low correlation between traits measured on yearlings and on heifers. A genetic correlation of .12 was found for NR56 calculated on yearling data and NR56 based on heifer data. This results in a different ranking for bulls, based on yearling data or on data of cows in lactation. Most fertility problems are found with lactating cows.

This is the main reason to use insemination data of lactating cows to estimate breeding values. It is important to select high producing animals while having no problems with fertility. The goal is to breed an animal which produces enough milk and is easily pregnant. This can be measured optimally in lactating cows. All this point to the use of NR56 and ICI for selection.

3. Index and responses

With parameters, based on De Jong (1993) in table 1, different alternatives for selection indexes for selection on fertility are examined for responses on ICI, NR56 and CI (table 2). The economic value for one day ICI or IC is set at fl 3.00 and for NR56 at fl 1.20.

For the first three alternatives (A to C) the selection response is computed, when using a single trait index for a single trait breeding goal and using information on 100 daughters. Selection on CI gives the largest variation in index and largest response on CI. However for CI this trait normally is measured on 2/3 of the bull's daughters of which NR56 and ICI is available. Alternative D is more realistic, with CI available on 70 daughters. Comparing alternative D to alternative B, B shows a larger variation in index and a higher response in CI. When using ICI and NR56 in the index (alternative E), the response in CI is even larger, although the variation in index shows a small decline. But CI is still for the farmer the most important breeding goal.

Table 1. Parameters for percentage calvings after first insemination (%CALF), NR56 for heifers (NR56), NR56 for yearlings (NR56_p), interval between calving and 1st insemination (ICI) and calving interval (CI).

| | Heritabilities and correlations | | | | | σ_p | σ_p |
|-------------------|---------------------------------|------|-------------------|------|------|------------|------------|
| | %CALF | NR56 | NR56 _p | ICI | CI | | |
| %CALF | .011 | .84 | .00 | .05 | -.62 | 5.10 | 48.05 |
| NR56 | .93 | .020 | .00 | .03 | -.42 | 6.55 | 46.35 |
| NR56 _p | .07 | .12 | .009 | .00 | .00 | 3.90 | 42.15 |
| ICI | .03 | .30 | -.10 | .060 | .50 | 6.15 | 25.10 |
| CI | -.50 | -.21 | .00 | .78 | .040 | 7.50 | 37.60 |

* Heritabilities are on the diagonal, lower triangle are genotypic correlations and upper triangle phenotypic correlations.

Table 2. Weighting factors for trait in the index, standard deviation of the selection index and response per trait in breeding goal.

| Alternative | A | B | C | D | E | F | G |
|-------------------------|-------|-------|-------|-------|--------------------------------|----------|-------|
| Breeding goal | NR56 | ICI | CI | CI | ICI+NR56 | ICI+NR56 | CI |
| Index | NR56 | ICI | CI | CI | ICI+NR56 +NR56 _p | ICI+NR56 | ICI |
| number daughters | 100 | 100 | 100 | 70 | 100 | 100 | 100 |
| <i>Weighting factor</i> | | | | | | | |
| ICI | - | -3.00 | - | - | -2.89 | -2.88 | - |
| NR56 | 1.20 | - | - | - | 0.90 | 0.89 | - |
| CI | - | - | -3.00 | -3.00 | - | - | -3.00 |
| NR56 _p | - | - | - | - | - | 0.38 | - |
| sd index | 4.55 | 14.33 | 14.76 | 13.23 | 12.92 | 12.93 | 13.63 |
| rih | .58 | .78 | .66 | .59 | .73 | .73 | .61 |
| <i>Response</i> | | | | | | | |
| ICI | 1.06 | -4.78 | -3.15 | -2.82 | -4.53 | -4.53 | -4.78 |
| NR56 | 3.78 | -1.53 | 0.90 | 0.81 | -0.57 | -0.56 | -1.53 |
| CI | -0.91 | -4.55 | -4.92 | -4.41 | -4.80 | -4.78 | -4.54 |

Including the NR56 measured on yearlings (alternative F) does not change the response compared to alternative E: NR56 measured on yearlings is not a good predictor to improve the fertility traits for lactating animals.

An index consisting of NR56 and ICI gives the best response on CI, while at the same time ICI is improved. NR56 shows a negative response with alternative E, although E is preferable to alternative B.

As for the farmer in The Netherlands CI is considered to be the main fertility trait for his cows, an index has been introduced with NR56 and ICI as the information sources and CI as the breeding goal.

The index is:

$$CI = ICI - .4 \cdot NR56$$

(days) (days) (%)

where CI is transmitting ability for calving interval.

4. Model

For the genetic evaluation insemination data of heifers are used. Traits evaluated are NR56 and ICI. The model used for the evaluation is:

$$Y_{ijklm} = HYS_i + M_j + DAM_k + S_l + e_{ijklm} \quad (1)$$

where:

- Y_{ijklm} = trait NR56 or ICI, measured on a cow during her first lactation;
- HYS_i = HYS i defined as herd*2 year period;
- M_j = month j of insemination (j=1,12)
- DAM_k = breed composition k of dam of cow (k=1,17);
- S_l = sire l of cow (random);
- e_{ijklm} = error term (random).

For the sire the relation matrix is added with his sire and maternal grandsire.

5. Selection on fertility

Improving fertility of cows can only be accomplished for a small part by improving the genetic ability of cows. Breeding values, needed for selection, give too little information (reliability factor) caused by the low heritability of fertility traits and the relatively small daughter groups of bulls. Improvement of fertility can be accomplished the best by good management.

Breeding values are a useful instrument to monitor the genetic ability for fertility of the cow population. Despite the low heritability a rather large variation in breeding values for bulls is found.

Literature

Jong, G. de (1993). Fokwaardeschatting voor indirecte vruchtbaarheidskenmerken. NRS-notitie.

Ouweltjes, W (1992). Onderzoek naar fokwaarden voor vruchtbaarheidskenmerken. NRS-notitie.